A Time Series Analysis Of The Japanese Yen With Monthly Data

MBA THESIS

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A TIME SERIES ANALYSIS OF

THE JAPANESE YEN WITH MONTHLY DATA

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By

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ABSTRACT

The purpose of this thesis is to obtain a function which will help in using the exchange rate between the Japanese Yen (Yen) and the United States Dollar (Dollar) as an investment alternative. A three-step method is followed throughout this study. Yen and the set of five countries` exchange and interest rates is searched at the first step. Mullticolinearity and nonstationarity problems are observed at this stage. At the second step the data set is converted into a stationary form by taking the first differences. Then regression is applied and no significant correlation is found. At the final step relation between Yen and three subgroups from the data set are examined and no significant relation is found again. This thesis concludes by explaining the outcomes of our analyses.

Keywords: Yen, Regression, Mullticolinearity, Stationarity

ÖZET

Bu tezin amacı Japon Yeni (Yen) ile Amerikan Doları (Dolar) arasındaki döviz kurunu bir yatırım allternatifi olarak kullanılmasında yardımcı olacak bir fonksiyon elde etmektir. Bu çalışma boyunca üç adımlı bir metod izlenmiştir. İlk adımda Japon Yeni ile beş ülkenin döviz kurları ve faiz oranlarından oluşan veri kümesi araştırılmıştır. Bu aşamada Çoklu Doğrusal Bağlantı ve Durağanlık problemleri ile karşılaşılmıştır. İkinci adımda veri kümesi birinci farklar alınarak durağan hale dönüştürülmüştür. Sonra regresyon uygulanmış ve anlamlı bir bağıntı olmadığı sonucuna varılmıştır. Son adımda Yen ile veri kümesinin üç alt grubu arasındaki ilişki incelenmiş ve anlamlı bir bağıntı bulunamamıştır. Tez analizlere ait sonuçların yorumlanması ile bitmektedir.

Anahtar Kelimeler : Yen, Regresyon, Çoklu Doğrusal Bağlantı, Durağanlık

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Galileo Galilei

I. INTRODUCTION

The exchange rate[1] of a currency is one of the most important and extensively used investment instruments in the international financial markets. Globalization and the increase in the number of open economies have expanded the importance of the value of currencies. Today, currencies are not only the media of exchange but also one of the most widely used investment tools.

This study tries to find how the discount and interest rates of Japan, the United States of America and major European Countries affect the exchange rate between Japanese Yen (Yen) and United States Dollar (Dollar). For this purpose the behaviour of the Japanese Yen (Yen) will be analyzed by using statistical methods with monthly data. Some of the factors that affect the value of Yen will be shown with their contribution to Yen's value in the exchange rate market.

The value of a currency is a function of economic and political factors. In this sense there are a number of factors which affect, via a very complex way, the exchange rate of a currency, however the mechanisms are not clear yet. To demonstrate the complexities the following example might be explanatory: The declaration of a war had a positive effect on the United States Dollar (Dollar) during the Gulf crisis in 1990. On the other hand, the same war had negative effects for the Iraqi economy. Dinar, the currency of Iraq, depreciated. The

[1]Exchange rate is the price of one monetary unit stated in terms of another currency unit. Throughout this study, unless stated otherwise, exchange rates are given in United States Dollar equivalents.

same war affected not only these two countries but also many others in the region. Most of the countries of the region had economic losses and their currencies depreciated.

The war also negatively influenced the Turkish economy, public's tendency towards using foreign currency as a way of investment exploded. Of course high inflation and the depreciation of the Turkish Lira pumped this trend. Today investing in foreign currencies is very common in Turkey.

Rather than carrying bank accounts of foreign exchange, investors may benefit from currency exchange rates in two ways. Whenever a price difference exists in different markets there is an arbitrage chance. The second opportunity is the forward markets in which a currency can be exchanged for another in agreements made to exchange currencies at a specific future time. It is obvious that whenever the spot price of the currency acquired is different to the forward price at the expiration date there is an arbitrage for one of the parties of the agreement.

The first opportunity stated above is related to the market efficiency. For markets in which prices reflect information instantaneously there is no arbitrage. Such markets are considered to be efficient. However, the time differences among the markets and interpretations of information may lead different expectations and result in different prices around the world for short periods. Prices adjust rapidly since even a small gap in the exchange rates would end up with large amounts of capital flows and high profits. On the other hand investors analyze the current information and try to estimate a future value of exchange rates for their forward contracts.

For both types of investments expectations play a major role. As will be discussed in the next chapter, there is no technically approved method for estimating the value of exchange rates. Hence, the interpretation of current information and subjective assessment may be very important. This study would help investors in their expectation formation stage with its quantitative perspective to the determinants of the value of Yen, one of the most important currencies of the global trade.

The idea of studying an estimation model for Yen arose with its continuous appreciation against dollar faster than any other major currency (Figure 1).

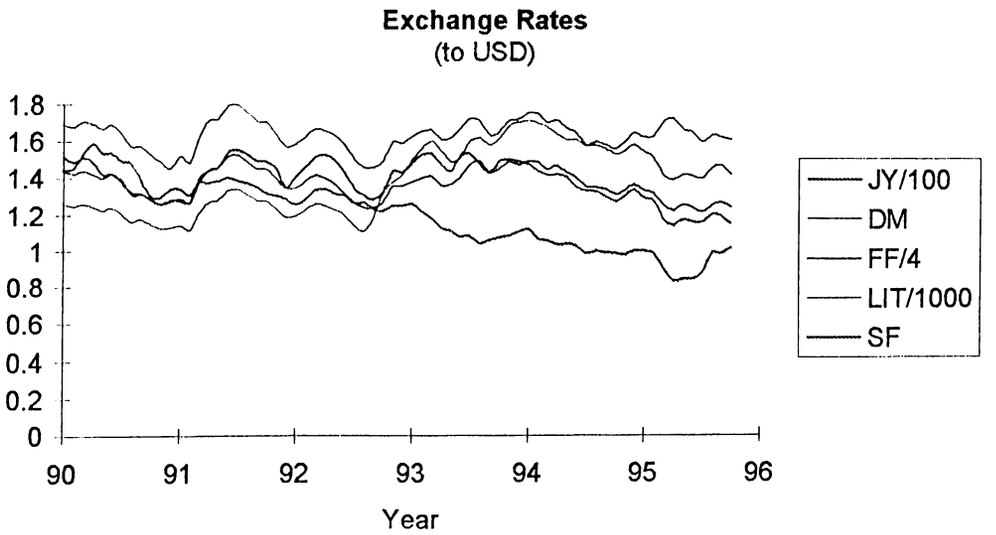

Figure 1

With this study investors may gain a different perspective to the behavioural pattern of Yen. They may assess a better expectation by considering the method and the outputs of this study. Besides the study aims to bestow an equation for the value of Yen.

The historical progress of the currency exchange rate systems and the literature, from the perspective of finance, are given in the next chapter. Chapter 3 discusses the method used and the analysis. Chapter 4 states the results and the final chapter presents the findings.

II. LITERATURE REVIEW

Until the collapse of the Bretton Woods system and the fixed exchange rates era - in 1973, economists and investors had not utilized exchange rates as an investment instrument. The only way of using exchange rate was converting dollar to gold within the fixed rates provided by the central banks. However, after 1973 exchange rates became an investment tool and all around the world both individuals and organizations started using exchange rates for various financial and investment purposes. It would be beneficial to briefly refer to the literature on exchange rates from a financial viewpoint.

The fixed rate system, also called pegged system, started with the establishment of gold standard which was in effect till the inter-war period after the World War I. The fixed rate system was ended with Bretton Woods system which was utilized between the years 1944 and 1973. The market mechanisms had almost no effect on the exchange rates and adjustments in the value of a currency were gradually done by governments according to the needs of trade balances.

During the fixed rate era, five approaches are distinguished in attempts to explain the changes in the exchange rates; purchasing power parity, elasticities, absorption, portfolio balance and the asset market approach. All of these approaches try to explain the behaviour of exchange rates during certain periods, throughout the pegged system, and not valid after fixed exchange rate system. The major pitfall of these approaches is the assumption of closed

economies and bilateral trade between two states. These theories fail to explain the complexities in current macroeconomic environment.

Market mechanisms start to determine the values of currencies with the collapse of the fixed exchange rate system. Demand and supply of currencies are the major factors underlying this change. The name of the new system, which is still in effect, is the floating exchange rate system. Governments continue to play the major role in the values of their currencies. The interest given by the central banks and other monetary tools such as money supply keep an important role. Today, central banks of G-7 Countries (the USA, Canada, Germany, France, Italy, the UK, Japan) sometimes intervene to market as buyers or sellers to prevent fluctuations. Meanwhile, research to date has not succeeded in formulating the cause and effect mechanisms which influence exchange rates.

The classical methods of estimation are based on the assumption that the mean and the variance of the variables are unique and are independent of time, such variables are called stationary. However, most of the macroeconomic time series do not satisfy the stationarity assumption, they are nonstationary.

Cointegration is a method for the treatment of unit root data introduced by Granger and Engel (1981). A group of nonstationary data is cointegrated if there is a stationary combination of these variables. This method is widely utilized in exchange rate forecasting. A normal interpretation of cointegration is a long run equilibrium. Deviations from the long run equilibrium are explained by the error correction[2] model which says a deviation from the long run

[2] $\Delta Y_t = \alpha \Delta t + \lambda(Y_{t-1} - \beta X_{t-1}) + e_t$
where Y_t and X_t are integrated of degree 1 - I(1) and $Y_t - \beta X_t$ is stationary i.e. I(0)

equilibrium would be reduced in the next period. If a cointegration relationship exists then a dynamic error correction relationship exists.

Copeland (1991), Liu, Gerlow and Irwing (henceforth Lui *et al.*, 1994) found no cointegration thus no forecasting value. Copeland (1991) studied DM, Yen, SF, FF and concluded that there is no arbitrage chance with these currencies. Lui *et al.* (1994) used Yen, the Canadian Dollar and ended up with the similar results.

On the other hand, McNown and Wallance (1994), Diebold, Gardeazabal and Yılmaz (henceforth Diebold *et al.*, 1994) found cointegration in their data set. Diebold *et al.* (1994) studied the Canadian Dollar, FF, DM, LIR, Yen, SF. McNown and Wallance (1994) who studied the three high-inflation economies of Chile, Argentina and Israel found cointegration with a set consisting of each country's domestic money supply industrial production rate inflation rate and exchange rate.

Perhaps the most striking studies using the cointegration method are the Baillie and Bollerslev's 1989 and 1994 studies. Even though they used the same data they ended up with contradicting results. Their first study claims a cointegration but the second study states a fractional cointegration. Thus they claim that exchange rates are not predictable.

Boyd and Doroodian (1993) use a martingale model, instead of a cointegration model, to test the efficiency of exchange rate. This model only takes the past values of a currency as variables, and looks for autocorelations. They used DM, Yen, SF and Pound and concluded that the exchange rate behaviour is approximately a random walk, thus the market of exchange rates is efficient.

There are several similar studies of the same nature stated above. Our effort to use the global effects of open economies enables us to use a different method rather than cointegration. The method used in this thesis tries to capture the interactions and interdependencies of economies by showing the contribution of different economic variables to Yen.

III. METHOD

Economic models of exchange rate do not capture the dynamics of the global economy. Most of the economic equations utilize bilateral relations between two countries. For example according to the purchasing power parity model exchange rate is a function of domestic and foreign price levels. However, the global trade and the open economies are not captured by any of the current economic models.

At this point it would be beneficial to understand the rationale behind the speculative capital flows which would help to understand the method used in this study. A speculative capital flows occurs when central banks are trying to maintain a fixed exchange rate for a currency when the market forces suggest that the currency's value is incorrect.

The information technology and the services provided by financial institutions enables investors to feasibly transfer their sources from one country to another. Despite the considerable transaction costs there is a theoretically existing arbitrage chance. The method described below is designed to show how the currency in question, Yen, is connected to the global market.

The relationship between Yen (JY) and a set of currencies and interest rates is searched by using multiple regression method. Stationarity and independence are two requirements for the variables of a regression. The general formula of regression is given below:

$$Y = C_0 + C_1 * X_1 + C_2 * X_2 + ... + e$$

where Y = dependent variable

C_i = contribution of independent variable

X_i = independent variable

e = random error & $e \sim N(0,\sigma^2)$

Testing the intercorrelations among the data set is the first step. The correlation matrix of the data set is analyzed for a possible mullticolinerity problem. Then the stationarity of data is tested with Augmented Dickey Fuller test (ADF). ADF looks for the time dependability of the variable in question. According to the test results regression will be revised with the differenced variables. Exchange rates of the other four countries are not included as independent variables in the regression of Yen since they are a function of Dollar thus they are not independent. However, the rest of the first-differenced variables are taken as groups according to the new intercorrelations among the data set. Three groups of variables are chosen for regression. The first group consists of the interest rates, three month treasury bill rate and discount rate of Japan. The exchange rate of Yen is defined in terms of Dollar so the second group contains three -month treasury bill rate and discount rate of USA. The third group consists of the interest and discount rates of Italy, France, Germany and Switzerland, i.e. the data set minus the previously used interest rates.

The data[3] used for the study are chosen on a monthly basis because of availability. Three groups of variables, the exchange rates, the three-month treasury bill and the discount rates of Japan, Germany, France, Italy, Switzerland and the United States of America between January 1990 and October 1995 are used. The monthly figures of bilateral trade balances among these countries would be helpful, however this information is not available. Abbreviations for the data set are given below.

Currencies

(All of the currencies are in the United States Dollar equivalent values)

JY = The Japanese Yen
DM = The German Mark
FF = The French Franc
LIT = The Italian Lira
SF = The Swiss Franc

Three -Month Treasury Bill Interest Rates:

J3 = Three Month Treasury Bill Interest Rate of Japan
D3 = Three -Month Treasury Bill Interest Rate of Germany
F3 = Three -Month Treasury Bill Interest Rate of France
I3 = Three -Month Treasury Bill Interest Rate of Italy
CH3= Three -Month Treasury Bill Interest Rate of Switzerland
US3= Three -Month Treasury Bill Interest Rate of the USA

Central Bank's Money Discount Rates:

Jd = Discount Rate of Japan
Dd = Discount Rate of Germany
Fd = Discount Rate[4] of France
Id = Discount Rate of Italy
Chd= Discount Rate of Switzerland
Usd= Discount Rate of USA

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[3] Source IMF International Financial Statistics.
[4] Central Bank of France does not use discount rate as a monetary instrument and keeps its value constant at 9.5 % , for that reason Fd will not be taken into consideration in the calculations

IV. RESULTS

This chapter discusses the outcomes of the method described in the previous chapter. The outputs obtained from the software used are presented in the appendices. The comments concerning these output are made throughout this chapter according to the steps of the methodology.

There appears a severe mullticolinerity problem among the data set. French Franc is intercorrelated to two variables namely German Mark and Swiss Franc. All others are tightly intercorrelated to each other where Italian Lira is the only variable being negatively correlated to other variables. Moreover very high correlations among the exchange rates are also observed when the correlation matrix in Appendix 1 is examined, the summary of Appendix 1 is given in Table1. Unfortunately these correlations prevent the application of regression since the variables seem not to be independent of each other.

To check the stationarity of the data ADF tests are applied. Table 2 on the next page summarizes ADF test results. According to the table all level variables but f_3 are nonstationary and are needed to be first differenced to fulfill the stationarity assumption. After that stage the first difference of the data set is taken and henceforth the data used in the analysis is the first-differenced data.

Table 1. Summary of correlation matrix

	dm	ff	lit	sf	j3	d3	f3	ı3	ch3	jd	dd	id
ff	0.98											
sf	0.90	0.86										
j3			-0.85									
d3			-0.94		0.82							
f3			-0.77			0.85						
ı3			-0.75			0.83						
ch3			-0.94		0.87	0.95	0.82					
us3												
jd			-0.87		0.98	0.86			0.88			
dd												
id			-0.86		0.89	0.94	0.89	0.87				
chd			-0.88		0.97	0.84		0.92		0.81	0.83	0.85
usd									0.98			

Table 2. The summary of ADF tests

Variable	ADF test St.	ADF test (with first	Critical Values	
Jv	-1,344	-5,099	%1	-3,5281
dm	-2,259	-4,799	%5	-2,9042
ff	-2,42	-5,299		
lit	-1,308	-5,434		
sf	-1,87	-5,751		
i3	-0,162	-8,217		
d3	-0,946	-8,527		
f3	-3,93	-9,249		
i3	-0,407	-3,207		
ch3	-0,175	-5,521		
us3	-2,012	-3,477		
id	1,006	-5,64		
dd	0,288	-5,253		
id	0,221	-2,359		
chd	1,142	-5,236		
usd	-1,643	-3,714		

A regression is applied to the stationary set. At this step the data set provides no significant equation. Table 3 which gives the regression summary is provided below.

Table 3. The summary for the regression with all of the variables

JY = 0.03 - 0.34 usd + 0.29 d3 + 0.34 f3 - 0.5 ıd - 0.55 j3 + 10.54 sf + 1.05 ch3 - 0.74 dd - 0.03 lit
+ 0.94 us3+ 10 chd + 2.4 jd + 27.57 dm + 0.16 ı3 + 6.57 ff

Multiple R	.58900
R Square	.34692
Adjusted R Square	.12427
Standard Error	3.48998

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	15	284.67716	18.97848
Residual	44	535.91683	12.17993

F = 1.55818 Signif F = .1263

The figure F in Table 3 states no significant relation between Yen and the variables at a 10% confidence level. Besides currencies in the equation are still intercorrelated (See Appendix 2.). Correlations among DM, FF, LIT, and SF are all above 0.65. The currencies are being given in Dollar exchange rate may cause this. Another effect is the European Monetary Union in which European Currencies are pagged to each other.

Next, Yen is regressed against three groups of variables. Descriptive statistics are given in Appendix 3. None of the equations provides either a significant R^2 or F value. Thus we conclude that Yen is independent of the data set.

Another interesting result is that Japanese interest rates do not have an influence on the value of Yen. To take the appreciation trend under control the discount rate and three month treasury bill rate of Japan have been decreased since 1990 but this policy has not succeeded in stopping its appreciation. In addition to Japanese government, G-7 countries act together and intervene the market by manipulating the interest rates and money supply. However, Yen is not so much influenced by monetary policies of other countries in the long run.

IV. CONCLUSION

In this study, the regression model is utilized for finding a function which would correlate Yen to the interest and exchange rates of five countries. The first regression is applied on the entire set of exchange, discount, three-months treasure bill rates of five countries. After doing so, Yen is analyzed respectively against three groups of data. The first group consists of Japanese discount and three-month treasure bill rates. The second one contains US discount and three-month treasure bill rates. The last group is the discount and three-month treasure bill rates of Germany, France, Italy and Switzerland.

The time series of currencies and interest rates used causes two problems for regression. These are the multicolinearity among the variables and the nonstationarity. The first problem gives misleading results since each variable is supposed to have a low correlation with the other variables in the regression equation. In the first step of our analysis the high corelations in the data set falsifies this assumption. The second problem caused by nonstationarity of the data is more fatal for the regression and is to be initially solved.

In order to cope with the nonstationarity problem the first differences of the variables are taken and the regression is applied with the new data. The regression

fails to give a significant equation. And there is still multicolinearity problem among the differenced data set.

The last step of our study, the regressions on three subgroups of data ends in four equations for Yen. However, none is significant due to the low R squares and F values. The results of the regressions indicate that Yen is not affected by other countries' discount rates and interest rates. Moreover regression of Yen on Japanese interest rates shows no relation between Yen and the variables in the data. This result is consistent with the fact that interest rates of Japan have been decreased since 1990 but this policy has not succeeded in stopping Yen's appreciation.

Finally, there are some limitations of the study. The data set is monthly and consists of seventy points, which is a considerably short interval for such a time series analysis. Besides monthly data may be insufficient in reflecting the fluctuations between two consecutive months. Daily data might be more appropriate for this study. In addition more macroeconomic indicators such as bilateral trade figures among countries in question may be taken into data set, but these figures are not easily available.

Eventually we have concluded with two main points. The first one is that Yen is not affected by three-month treasure bill and interest rates of Germany, France, Italy, Switzerland and the USA. The second one is that Yen is not affected by the Japanese domestic three-month treasure bill and interest rates.

APPENDIX 1

CORRELATION MATRIX WITH RAW DATA

	jy	dm	ff	lit	sf	
	2	3	4	5	6	
jy	1.0000					
dm	0.4394	1.0000				
ff	0.3202	0.9801	1.0000			
lit	-0.8302	-0.0076	0.1156	1.0000		
sf	0.5062	0.9027	0.8623	-0.1413	1.0000	
j3	0.9028	0.3066	0.2141	-0.8456	0.3078	
d3	0.8598	0.1922	0.0687	-0.9395	0.3737	
f3	0.7771	0.0996	-0.0085	-0.7673	0.3528	
I3	0.5474	-0.2711	-0.3748	-0.7479	-0.0067	
ch3	0.9216	0.2372	0.1150	-0.9444	0.3720	
us3	0.4651	-0.0442	-0.0698	-0.3663	-0.2108	
jd	0.8913	0.2995	0.2035	-0.8674	0.3179	
dd	0.5250	0.2344	0.1374	-0.5845	0.5373	
id	0.8229	0.0443	-0.0816	-0.8621	0.2675	
chd	0.8332	0.2875	0.1729	-0.8832	0.4876	
usd	0.5195	-0.0385	-0.0688	-0.4288	-0.1825	

	j3	d3	f3	I3	ch3	
	7	8	9	10	11	
j3	1.0000					
d3	0.8150	1.0000				
f3	0.6822	0.8541	1.0000			
I3	0.4945	0.7691	0.8311	1.0000		
ch3	0.8712	0.9500	0.8217	0.7076	1.0000	
us3	0.5938	0.1791	0.1435	0.0699	0.3621	
jd	0.9831	0.8590	0.7026	0.5298	0.8759	
dd	0.3695	0.7707	0.7651	0.6814	0.6319	
id	0.7324	0.8948	0.9350	0.8887	0.8737	
chd	0.7596	0.9709	0.8461	0.7131	0.9284	
usd	0.6713	0.2569	0.2363	0.1491	0.4187	

	us3	jd	dd	id	chd	usd
	12	13	14	16	17	18
us3	1.0000					
jd	0.5081	1.0000				
dd	-0.4202	0.4469	1.0000			
id	0.2375	0.7461	0.7209	1.0000		
chd	0.0737	0.8097	0.8373	0.8511	1.0000	
usd	0.9784	0.5933	-0.3354	0.3282	0.1495	1.000

APPENDIX 2

SPSS OUTPUT WITH STATIONARY DATA

- - Correlation Coefficients of differenced data -

	CH3	CHD	D3	DD	DM	F3
CH3	1.0000	.2519*	-.0359	-.0244	.0044	.1857
CHD	.2519*	1.0000	.0390	.4911**	-.1213	.0388
D3	-.0359	.0390	1.0000	.0410	-.1151	-.0091
DD	-.0244	.4911**	0410	1.0000	-.1327	.0240
DM	.0044	-.1213	-.1151	-.1327	1.0000	-.0974
F3	.1857	-.0388	-.0091	.0240	-.0974	1.0000
FF	-.0213	-.1409	-.1638	-.1293	.9502**	-.0766
I3	.2019*	.2861**	.1015	.0223	-.2164*	.0878
ID	.0894	.2909*	-.0213	.0791	-.0548	.0035
J3	.0050	-.2025*	.0047	-.1223	.1650	-.0336
JD	-.0676	.1600	.0464	-.0390	.1029	-.0198
JY	.1863	.0147	-.0108	-.0468	.4567**	.1549
LIT	-.2270*	-.2041*	.0079	-.2205*	.6446**	.0075
SF	.0266	-.0606	-.1124	-.1137	.8349**	-.0625
US3	.1747	-.0631	-.1292	-.3364*	.1780	-.0568
USD	.0541	-.0135	.0025	-.2590*	.1233	-.0106

	FF	I3	ID	J3	JD	JY
CH3	-.0213	.2019*	.0894	.0050	-.0676	.1863
CHD	-.1409	.2861**	.2909*	-.2025*	.1600	.0147
D3	-.1638	.1015	-.0213	.0047	.0464	-.0108
DD	-.1293	.0223	.0791	-.1223	-.0390	-.0468
DM	.9502**	-.2164*	-.0548	.1650	.1029	.4567**
F3	-.0766	.0878	.0035	-.0336	-.0198	.1549
FF	1.0000	-.2230*	-.0923	.1537	.0723	.4391**
I3	-.2230*	1.0000	.9221**	.0275	.5839**	-.0507
ID	-.0923	.9221**	1.0000	.0382	.6285**	-.0188
J3	.1537	.0275	.0382	1.0000	.1657	.0436
JD	.0723	.5839**	.6285**	.1657	1.0000	.1819
JY	.4391**	-.0507	-.0188	.0436	.1819	1.0000
LIT	.6800**	-.0453	.0285	-.0159	.0654	.1777
SF	.8363**	-.1813	-.0488	.0411	.0723	.4463**
US3	.2034*	.0150	-.0092	.0830	.2348*	.1726
USD	.0465	-.0520	-.0215	.0932	.1034	.0538

	LIT	SF	US3	USD
CH3	-.2270*	.0266	.1747	.0541
CHD	-.2041*	-.0606	-.0631	-.0135
DD	-.2205*	-.1137	-.3364**	-.2590*
DM	.6446**	.8349**	.1780	.1233
F3	.0075	-.0625	-.0568	-.0106
FF	.0079	-.1124	-.1292	.0025
D3	.6800**	.8363**	.2034*	.0465
I3	-.0453	-.1813	.0150	-.0520
ID	.0285	-.0488	-.0092	-.0215
J3	-.0159	.0411	.0830	.0932
JD	.0654	.0723	.2348*	.1034

JY	.1777	.4463**	.1726	.0538
LIT	1.0000	.5695**	.1104	.1463
SF	.5695**	1.0000	.2446*	.0466
US3	.1104	.2446*	1.0000	.5526**
USD	.1463	.0466	.5526**	1.0000

* - Signif. LE .05 ** - Signif. LE .01

SPSS REGRESSION WITH STATIONARY DATA

**** MULTIPLE REGRESSION ****

Listwise Deletion of Missing Data

	Mean	Std Dev
JY	-.570	3.729
CH3	-.059	.329
CHD	-.042	.207
D3	-.030	1.028
DD	-.030	.253
DM	-.007	.044
F3	-.064	2.085
FF	-.023	.140
I3	-.189	1.616
ID	-.163	1.335
J3	-.097	.645
JD	-.079	.372
LIT	.708	36.607
SF	-.005	.044
US3	-.031	.198
USD	-.013	.196

Dependent Variable.. JY

. Method: Enter
CH3 CHD D3 DD DM F3 FF I3
ID J3 JD LIT SF US3 USD

Multiple R	.58900
R Square	.34692
Adjusted R Square	.12427
Standard Error	3.48998

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	15	284.67716	18.97848
Residual	44	535.91683	12.17993

F = 1.55818 Signif F = .1263

---------- Variables in the Equation ----------

Variable	B	SE B	95% Confdnce	Intrvl B	Beta
USD	-.340876	3.315330	-7.022484	6.340733	-.017942
D3	.288981	.503466	-.725688	1.303650	.079623
F3	.336501	.237179	-.141502	.814504	.188153
ID	-.506206	1.145754	-2.815322	1.802909	-.181164
J3	-.548800	.806338	-2.173868	1.076267	-.094849
SF	10.539471	21.352748	-32.494165	53.573107	.122964
CH3	1.048177	1.697949	-2.373814	4.470169	.092498
DD	-.739246	2.359375	-5.494253	4.015762	-.050080
LIT	-.029098	.021226	-.071877	.013680 -	.285624
US3	.936133	3.327498	-5.769999	7.642266	.049579
CHD	.098961	3.098401	-6.145457	6.343379	.005485

JD	2.396694	1.832375	-1.296216	6.089603	.239385
DM	27.574257	37.408826	-47.818279	102.966793	.328494
I3	.164265	1.025067	-1.901622	2.230153	.071167
FF	6.567972	12.633832	-18.893843	32.029788	.245733
(Constant)	.032786	.490648	-.956050	1.021623	

---------- in ----------

Variable	T	Sig T
USD	-.103	.9186
D3	.574	.5689
F3	1.419	.1630
ID	-.442	.6608
J3	-.681	.4997
SF	.494	.6241
CH3	.617	.5402
DD	-.313	.7555
LIT -1.371	.1774	
US3	.281	.7798
CHD	.032	.9747
JD	1.308	.1977
DM	.737	.4650
I3	.160	.8734
FF	.520	.6058
(Constant)	.067	.9470
DM	.737	.4650
I3	.160	.8734
FF	.520	.6058
(Constant)	.067	.9470

**** MULTIPLE REGRESSION ****

Dependent Variable.. JY

Method: Enter
CH3 CHD D3 DD F3 I3

Variable(s) Entered on Step Number
1.. I3
2.. DD
3.. F3
4.. D3
5.. CH3
6.. CHD

Multiple R	.24225
R Square	.05868
Adjusted R Square	-.03545
Standard Error	3.66448

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	6	50.22855	8.37142
Residual	60	805.70322	13.42839

F = .62341 Signif F = .7108

---------- Variables in the Equation ----------

Variable	B	SE B	Beta	T	Sig T
I3	-.192529	.310134	-.083258	-.621	.5371
DD	-1.176670	2.085341	-.083404	-.564	.5747
F3	.250586	.234574	.137931	1.068	.2897
D3	.016796	.465236	.004562	.036	.9713
CH3	1.529347	1.333763	.157539	1.147	.2561
CHD	.778402	2.782053	.044047	.280	.7806
(Constant)	-.479609	.468925	-1.023	.3105	

APPENDIX 3

SPSS REGRESSIONS BY GROUPING

Yen as a function of J3 & Jd

**** MULTIPLE REGRESSION ****

Dependent Variable.. JY
Method: Enter J3 JD

Variable(s) Entered on Step Number
1.. JD
2.. J3

Multiple R	.18237
R Square	.03326
Adjusted R Square	.00396
Standard Error	3.56072

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	2	28.78731	14.39365
Residual	66	836.79462	12.67871

F = 1.13526 Signif F = .3275

---------- Variables in the Equation ----------

Variable	B	SE B	95% Confdnce	Intrvl B	Beta
JD	1.821312	1.244829	-.664069	4.306692	.179559
J3	.082125	.727594	-1.370564	1.534814	.013852
(Constant)	-.481315	.441642	-1.363082	.400452	

---------- in ----------

Variable	T	Sig T
JD	1.463	.1482
J3	.113	.9105
(Constant)	-1.090	.2798

Yen as a function of Us3 & Usd

**** MULTIPLE REGRESSION ****
Dependent Variable.. JY
Method: Enter US3 USD

Variable(s) Entered on Step Number
1.. USD
2.. US3

Multiple R	.17829
R Square	.03179
Adjusted R Square	.00200
Standard Error	3.58927

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	2	27.49292	13.74646
Residual	65	837.38558	12.88286

F = 1.06704 Signif F = .3500

---------- Variables in the Equation ----------

Variable	B	SE B	95% Confdnce	Intrvl B	Beta
USD	-1.148064	2.855553	-6.850998	4.554870	-.058877
US3	3.802840	2.730624	-1.650592	9.256272	.203945
(Constant)	-.523791	.439800	-1.402132	.354551	

---------- in ----------

Variable	T	Sig T
USD	-.402	.6890
US3	1.393	.1685
(Constant)	-1.191	.2380

Yen as a function of Ch3, Chd, D3, DD, F3 & I3

**** MULTIPLE REGRESSION ****

Listwise Deletion of Missing Data
Dependent Variable.. JY

Method: Enter
CH3 CHD D3 DD F3 I3

Variable(s) Entered on Step Number
1.. I3
2.. DD
3.. F3
4.. D3
5.. CH3
6.. CHD

Multiple R	.24225
R Square	.05868
Adjusted R Square	-.03545
Standard Error	3.66448

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	6	50.22855	8.37142
Residual	60	805.70322	13.42839

F = .62341 Signif F = .7108

---------- Variables in the Equation ----------

Variable	B	SE B	Beta	T	Sig T
I3	-.192529	.310134	-.083258	-.621	.5371
DD	-1.176670	2.085341	-.083404	-.564	.5747
F3	.250586	.234574	.137931	1.068	.2897
D3	.016796	.465236	.004562	.036	.9713
CH3	1.529347	1.333763	.157539	1.147	.2561
CHD	.778402	2.782053	.044047	.280	.7806
(Constant)	-.479609	.468925	-1.023	.3105	

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